

# Module 6 - Laser Safety Tools

PDF Version

NOTE: It is recommended that you view the interactive online version for the best explanation of the laser-safety concepts.

### Laser Safety Tools

After completing this module, you will be able to:

- recognize the three levels of control measures.
- recall the importance of interlocks and access control light panels.
- recognize when to use beam blocks.
- recognize when to use special beam enclosures.
- identify several ways to view beams indirectly.
- recognize how to avoid interactions with beams through walking paths.



### Audio Narration (slide 1)

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- Recognize when to use beam blocks.
- Recognize when to use special beam enclosures.
- Identify several ways to view beams indirectly.
- Recognize how to avoid interactions with beams through walking paths.
- Recognize Laser Controlled Areas (LCAs).
- Describe the importance of a Nominal Hazard Zone (NHZ).

#### Levels of Controls

1. Engineered Controls
2. Administrative Controls
3. Personal Protective Equipment



#### Audio Narration (slide 2)

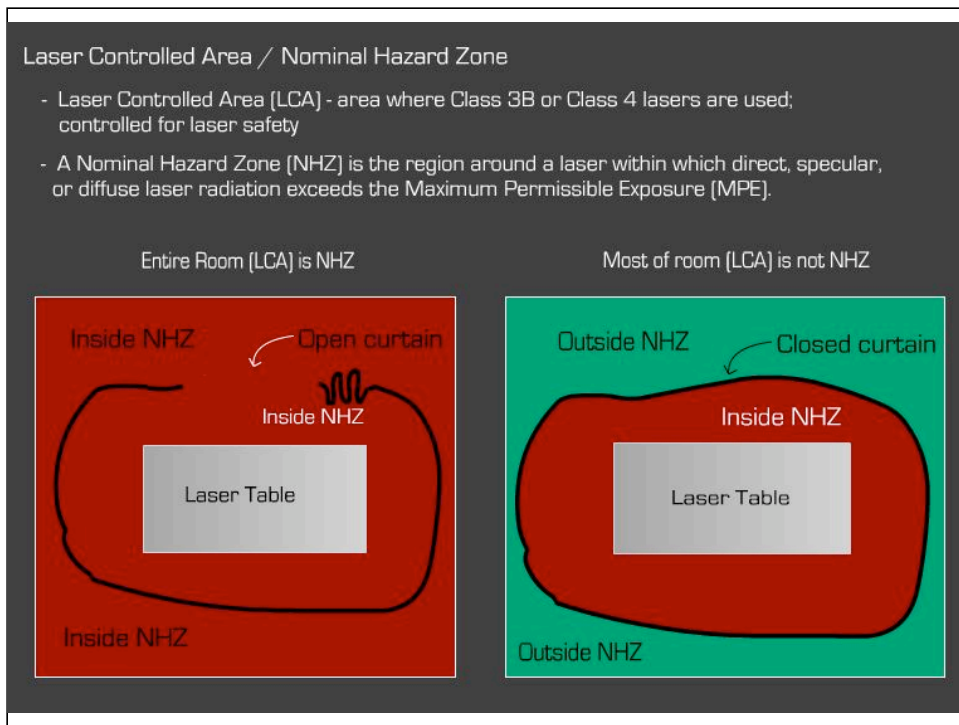
Three levels of safety controls are used to protect against laser hazards.

Engineered controls (such as interlocks, curtains, and shutters) are best because they do not require human decisions to be effective.

Administrative controls (such as training, procedures, signs, and monitoring the work environment) are also useful, but require good human decision making.

Personal Protection Equipment, or PPE (things like laser eyewear and protective clothing) can also be useful, but require continual human attention regarding fit and use.

We will discuss administrative controls and PPE in later modules. Here, we'll discuss engineered controls that are available to you. We like to call them "Laser Safety Tools."



Audio Narration (slide 3)

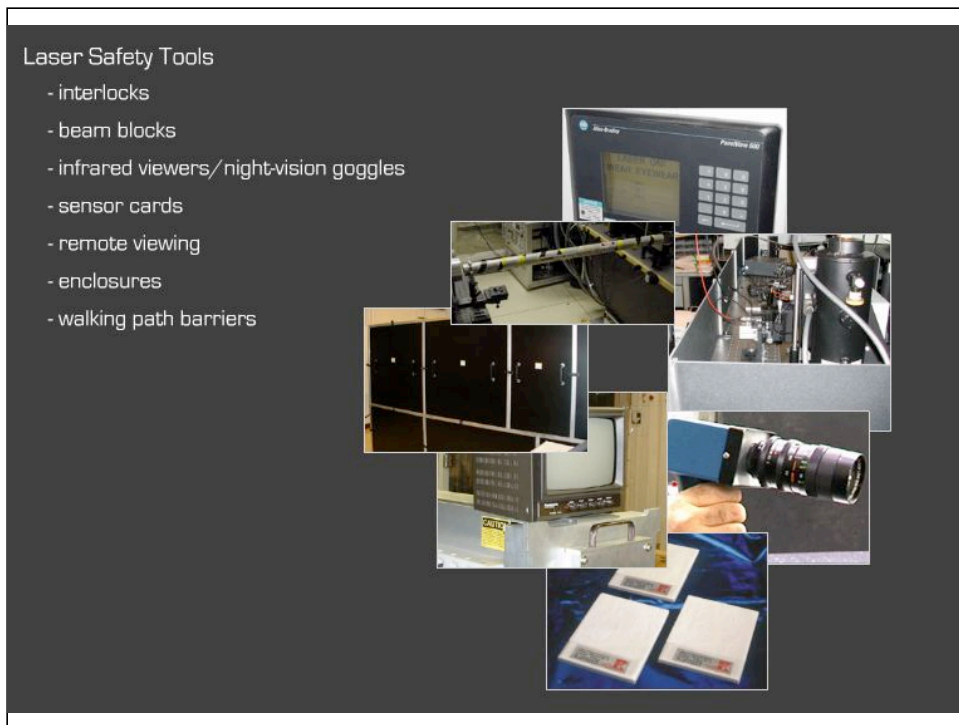
A Laser Controlled Area (LCA) is an area where Class 3B or Class 4 lasers are being used. LCAs must have specific postings and controls. We will discuss access control light panels and warning signs used with LCAs in this and the following module.

A Nominal Hazard Zone (NHZ) is the region around a laser within which direct, specular, or diffuse laser radiation exceeds the Maximum Permissible Exposure (MPE). The boundaries of the NHZ are established by the LSO.

Factors that may affect placement of the NHZ include:

- laser power, beam diameter and divergence;
- optical setup parameters, including lens characteristics, reflective surfaces in the operating area, and viewing angles; and
- MPE.

***Remember, laser eyewear is REQUIRED within an NHZ!***



#### Audio Narration (slide 4)

There are many devices and creative ideas to help maintain safety when working with lasers. These “Laser Safety Tools” are available to you and should be implemented whenever possible:

- Interlocks
- Beam Blocks
- IR Viewers/Night-vision goggles
- Sensor Cards
- Remote Viewing
- Enclosures
- Walking Path Barriers

Let’s look at how these tools can help you keep your workplace safe.

### Interlocks (and Access Control Light Panels)

- associated with many classes of lasers
- most commonly used with class 3B and 4 lasers
- protects unauthorized individuals
- gives status of laser
- check for functionality annually (or more often if required)



### Audio Narration (slide 5)

Laser room interlocks are one of the most common laser safety tools used to control access to laser labs. Interlocks are most commonly used with Class 3B and Class 4 lasers. However, some labs with lower power lasers also may be interlocked.

The interlock itself does nothing to make the user safer. It is only to protect unauthorized individuals who may enter the laser area.

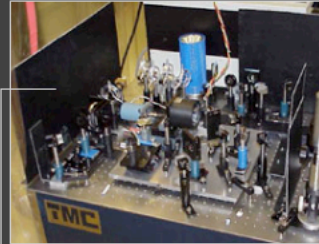
These systems use a digital sign or access control light panel to display the status of the laser to anyone wanting to enter the laser area. For instance, the interlock sign might display “Safe to Enter”, “Laser on Wear Eyewear”, or “Carry Required Eyewear” depending on the circumstance. If an unauthorized person were to enter a lab with the sign displaying “Laser On” the interlock would shut the laser down, probably to the dismay of the researcher.

Interlocks should be checked for functionality at least annually - or more often if required. Follow approved entry procedures associated with interlocked laser operations at a given site.

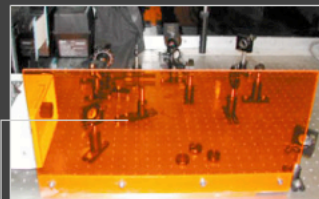
## Beam Blocks

When choosing, consider:

- combustibility.
- durability.
- reflectivity.
- optical density.



standard beam block



wavelength specific beam block

## Audio Narration (slide 6)

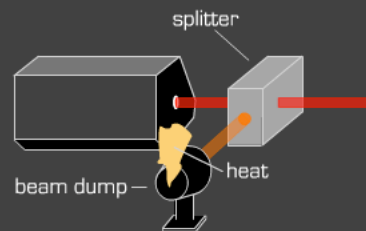
Beam blocks are barriers that can serve as perimeter guards to keep beams and reflections on tables. Or, they can be used as local blocks behind optics. When choosing beam blocks you must consider:

- Combustibility
- Durability
- Level of reflectivity
- Optical density

Ask yourself: What effect will the wavelength I'm working with have on these materials? Using the correct materials and placing them properly can successfully reduce diffuse reflections and stray beams.

### *Beam Dumps*

- specialized beam blocks used to absorb laser energy



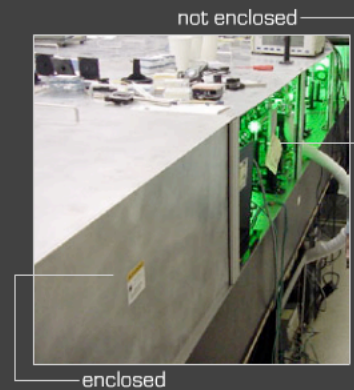
Audio Narration (slide 7)

Beam dumps are special beam blocks used to absorb the energy from the laser. A beam splitter may direct a portion of a beam into a beam dump. The energy is radiated out as heat.



#### Enclosures & Protective Housings

- minimize diffuse and specular reflections
- may be interlocked

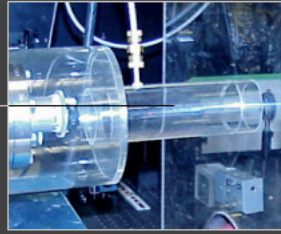


#### Audio Narration (slide 8)

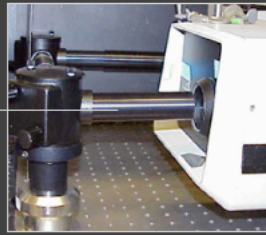
Any steps taken to keep diffuse or specular reflections to a minimum provide for a safer work environment. Sometimes this is accomplished by building an enclosure around the optical table or the individual laser system. These panels, as a general rule, are not interlocked. However, read labels and signs carefully. Some may indeed be interlocked.

## Beam Tubes

- enclose beam along path



UV plastic beam tube



metal beam tube

## Audio Narration (slide 9)

Beam tubes enclose a laser beam along its path. They may be made of plastic or metal and can be permanent or temporary. Not only do they keep you and other objects out of the beam path, they also limit air turbulence and dust.

## Viewers

### Uses:

- alignment
- locating stray beams

### Types:

- ultraviolet
- infrared [ $< 1700\text{nm}$ ]

### NOTE:

direct viewing of wavelengths  $>700\text{ nm}$  should never be attempted. Always use an indirect method of viewing along with proper protective eyewear.



Infrared (IR) viewer



night vision scope



night vision goggles

## Audio Narration (slide 10)

Viewers are available to enable you to see invisible beams during alignment procedures. These viewers can also be used to locate stray beams. Night-vision goggles also are very good for this.

Several types and styles of viewers are available for ultraviolet beams and for infrared beams up to 1700 nanometers.

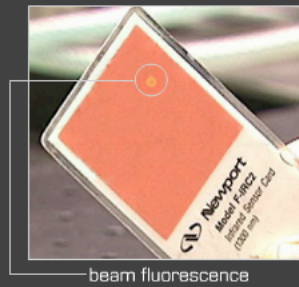
NOTE: direct viewing of wavelengths  $>700\text{ nm}$  should never be attempted—always use an indirect method of viewing along with proper protective eyewear.

### Sensor Cards

- another way of locating invisible beams
- be cautious of specular reflections from cards

Also use:

- polaroid paper
- burn paper



### Audio Narration (slide 11)

Sensor cards are another way to locate invisible beams. With a sensor card, the beam will produce a burn, fluorescence, or glow depending on the material used. Some cards are smooth; others have rough surfaces. Be cautious of specular reflections from sensor cards.

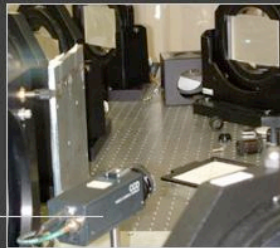
Polaroid paper and burn paper can also be used for this purpose.

### Remote Viewing

- safer than viewing directly
- remote viewing definitely should be considered when using Class 4 lasers



remote viewing monitor



remote viewing camera

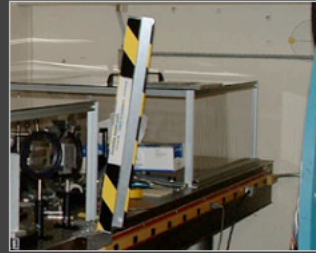
### Audio Narration (slide 12)

You can view a beam interaction with a target much more safely from a video monitor than by standing over the laser beam. This is known as remote viewing. Remote viewing definitely should be considered with Class 4 lasers.

### Space Between Tables

Prevents:

- walking through these areas.
- injury.
- work interruption.



barrier up when laser off



barrier locked in place

### Audio Narration (slide 13)

Sometimes beams are required to pass between tables or other open spaces. Walking through these active beam paths can be dangerous as well as interrupt data collection. Barriers - temporary or permanent - should be used to block traffic through the active beam path.

### Other Laser Safety Tools

Here are some other examples of laser safety tools. Consult with your LSO for suggestions in solving laser safety and containment problems. Rollover each of the buttons with your mouse to see more information about that tool.



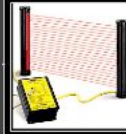
Curtains are used to divide rooms and keep light within the curtained area.



Neutral density filters are used to reduce the intensity of a beam.



An iris is used both to define a beam perimeter and to aid in centering a beam on a desired path."



A light curtain is an interlock device that is tripped by an object passing through the curtain beams.



Pressure pads are interlock devices activated by being stepped on.

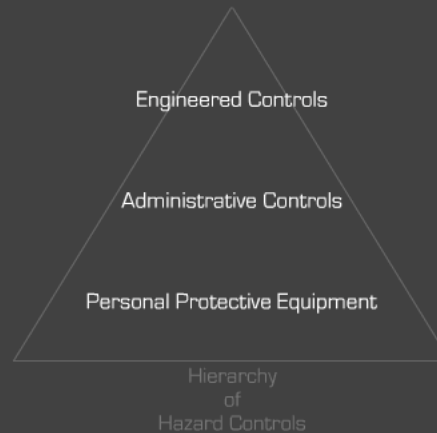
Audio Narration (slide 14)

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### Control Alternatives

The LSO has the authority and flexibility to replace an engineering control with a less restrictive control.

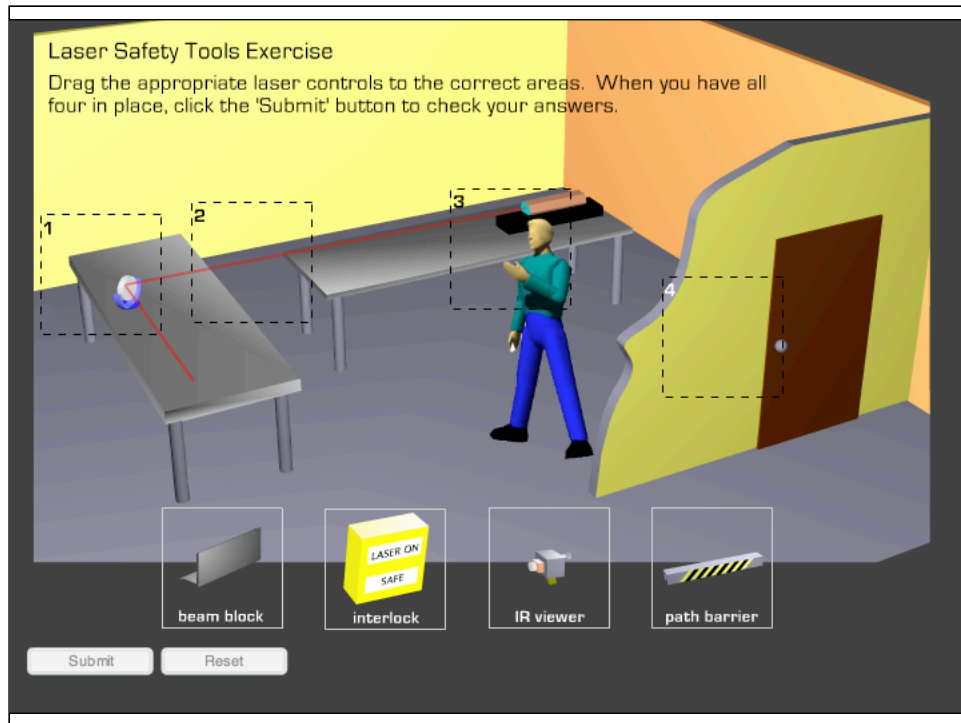
Users must receive orientation to new or alternative controls.



### Audio Narration (slide 15)

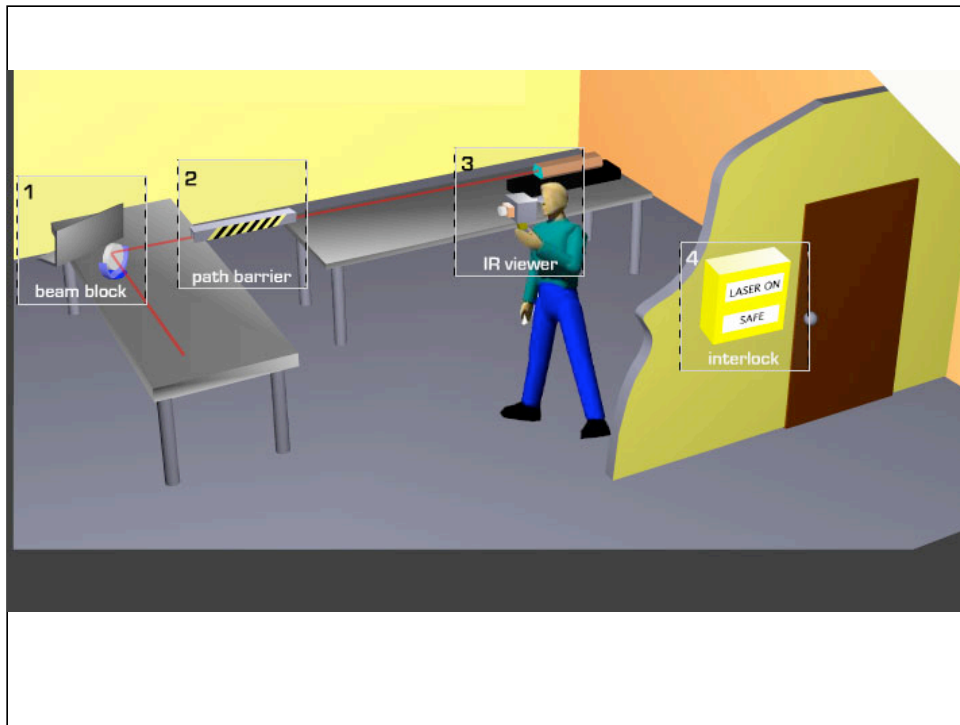
The LSO has the authority and flexibility to replace an engineering control with a less restrictive engineering or administrative control where the new control provides an equivalent level of safety or assures greater safety compliance. Contact your LSO to help you implement controls in your workplace. Users must receive orientation to any new or alternate controls.





Laser Safety Tool Exercise (slide 16)

Match the appropriate controls to the correct areas. See the answers on the next page.



Laser Safety Tool Exercise (slide 16 - continued)

1. Beam block
2. Path barrier
3. IR viewer
4. Interlock

## Laser Safety Tools Quiz

Pretests and end-of-module quizzes are only available online. This quiz must be successfully completed. To do so, access the online course and go to the menu. Here, select module 6 and then advance through the slides until you reach the last slide (the quiz).